Exercice 1 :

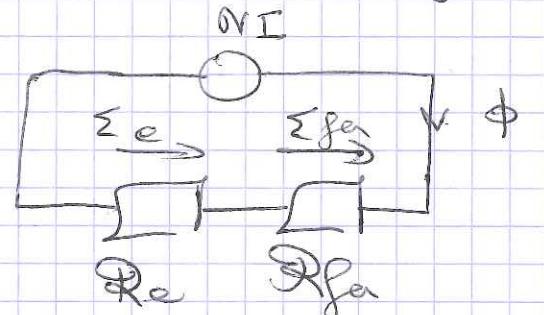
$\mu_r = 10^3 \quad l_{fer} = 0,2\,m$

$S = 10.10^{-4}\,m^2$

$e = 10^{-3}\,m.$

$NI = 25 \times 2 = 50\,At.$

$B_{fer} = 1,25 . B_{entrefer}$



Be ? He ?
Bfer ? Hfer ?

$\Sigma_e = R_e . \Phi = H_e . l_e \qquad \Sigma_{fer} = R_{fer} . \Phi$

$\Sigma_e = \frac{B_e}{\mu_0} . l_e \qquad \Sigma_{fer} = \frac{B_{fer}}{\mu_0 \mu_r} . l_{fer}$

$NI = \Sigma_e + \Sigma_{fer} = \frac{B_e}{\mu_0} l_e + \frac{B_{fer}}{\mu_0 \mu_r} l_{fer}$

$NI = \frac{B_{fer}}{1,25\,\mu_0} l_e + B_{fer} . \frac{1}{\mu_0 \mu_r} l_{fer}$

$NI = \frac{B_{fer}}{\mu_0} . \left(\frac{l_e}{1,25} + \frac{l_{fer}}{\mu_r} \right)$

$B_{fer} = \frac{\mu_0 NI}{\left(\frac{l_e}{1,25} + \frac{l_{fer}}{\mu_r} \right)} = \frac{4\pi . 10^{-7} . 50}{\left(\frac{10^{-3}}{1,25} + \frac{2.10^{-1}}{10^3} \right)}$

$B_{fer} = \frac{2\pi . 10^{-7+1+1}}{(8.10^{-4} + 2.10^{-4})} = \frac{2\pi . 10^{-5}}{10.10^{-4}}$

$B_{fer} = 2\pi . 10^{-2} = 0,0628\,T$

$$H_{fer} = \frac{B_{fer}}{\mu_0 \mu_r} = \frac{2\pi}{\frac{6,28 \cdot 10^{-2}}{4\pi \cdot 10^{-7} \cdot 10^3}} \quad (2\pi \approx 6,28)$$

$$H_{fer} = 5 \cdot 10^{(-1-2+7-3)}$$

$$H_{fer} = 5 \cdot 10^{+1} = 50 \text{ At.wb}^{-1}$$

$$B_{entrefer} = \frac{B_{fer}}{1,25} = \frac{2\pi \cdot 10^{-2}}{1,25} = 5,028 \cdot 10^{-2} \text{ T.}$$

$$H_{entrefer} = \frac{B_{entr}}{1,25} \times \frac{1}{\mu_0 \times 1} = \frac{H_{fer} \cdot 10^3}{1,25}$$

$$H_{entrefer} = \frac{50 \cdot 10^3}{1,25} = 4 \cdot 10^4 \text{ At.wb}^{-1}$$

Exercice II

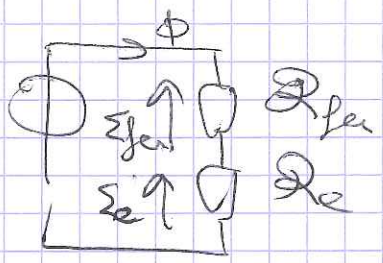
$N = 30$ spires $\quad \mu_r = 10^3 \quad e = 1 \text{ mm.}$

$l_{fer} = 0,3 \text{ m.} \quad S_{fer} = 10 \text{ cm}^2.$

$S_e = 12 \text{ cm}^2.$

1. $I = 8A. \quad B_e ?$

$NI = 30 \times 8 = 240 \text{ At.}$



$$NI = \mathcal{E}_{fer} + \mathcal{E}_e = (\mathcal{R}_{fer} + \mathcal{R}_e) \cdot \Phi$$

$$\Phi = B_{fer} \times S_{fer} = B_{ent} \times S_{ent}$$

d'où $\quad NI = (\mathcal{R}_{fer} + \mathcal{R}_e) \cdot B_{ent} \cdot S_{ent}$

$$B_{ent} = \frac{NI}{(\mathcal{R}_{fer} + \mathcal{R}_{ent})\, S_{entrefer}}$$

$$\mathcal{R}_{fer} = \frac{1}{\mu_0 \mu_r} \cdot \frac{l_{fer}}{S_{fer}} = \frac{3.10^{-1}}{4\pi.10^{-7}.10^{3}.10^{4}.10^{-4}}$$

$$\mathcal{R}_{fer} = \frac{3}{4\pi} \cdot 10^{-1+7} = 0{,}238.10^{+6}$$

$$= 2{,}38.10^{5}\ At.wb^{-1}$$

$$\mathcal{R}_{ent} = \frac{1}{\mu_0 \times 1} \times \frac{e}{S_{ent}} = \frac{10^{-3}}{4\pi.10^{-7}.12.10^{-4}}$$

$$\mathcal{R}_{ent} = 7{,}95.10^{-2}.10^{(-3+11)}$$

$$= 7{,}95.10^{+6}\ At.wb^{-1}$$

D'où $B_{ent} = \dfrac{240}{(23{,}8.10^{4} + 795.10^{4}).12.10^{-4}}$

$$B_{ent} = \frac{240}{818{,}8 \times 12} = 0{,}0244\ T$$

2. ϕ

$$\phi = B_{ent} \cdot S_{ent} = 24{,}4.10^{-3} \times 12.10^{-4}$$

$$= 292{,}8.10^{-7}$$

$$= 29{,}28.10^{-6}\ wb$$

$$\phi = 29{,}28\ \mu Wb.$$

3. $\phi_{total} = N \times \phi = 30 \times \phi$

$$\phi_{tot} = 878{,}4\ \mu Wb.$$

Exercice 3:

Section Carrée 2×2 cm^2.

$\mu_r = 10^4$

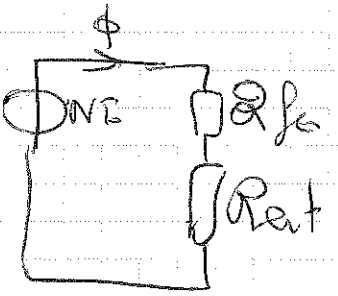
$S_{ent} = S_{fer}$

$l_{moy} = 2\pi \times \left(\frac{R_1 + R_2}{2}\right) = 2\pi \times 5.10^{-2}$
$= 0{,}314$ m.

R_{moy}

On négligera devant l_{moy}.

1)



$NI = \mathcal{R}_{fer} \cdot \Phi + \mathcal{R}_{ent} \cdot \Phi$

$= (\mathcal{R}_{fer} + \mathcal{R}_{ent})\Phi$

$\Rightarrow \quad \Phi = \frac{NI}{\mathcal{R}_{fer} + \mathcal{R}_{ent}}$

$\mathcal{R}_{fer} = \frac{1}{\mu_0 \mu_r} \cdot \frac{l_{moy}}{S_{fer}} = \frac{3 \times 10^{-1}}{4\pi \cdot 10^{-7} \cdot 10^4 \cdot 4 \cdot 10^{-4}}$

$\mathcal{R}_{fer} = \frac{1}{16} \cdot 10^{-1+7}$

$= 6{,}25 \cdot 10^{-2+6} = 6{,}25 \cdot 10^4$ At.wb^{-1}

Donc $\Phi = \frac{20 \cdot I}{\left(6{,}25 \cdot 10^4 + \frac{e}{\mu_0 \cdot S}\right)}$

$\Phi = \frac{20\, I}{\left(6{,}25 \cdot 10^4 + \frac{e}{4\pi \cdot 10^{-7} \cdot 4 \cdot 10^{-4}}\right)} = \frac{20\, I}{\left(6{,}25 \cdot 10^4 + 19{,}89 \cdot 10^{-3+8} \cdot e\right)}$

$\Phi = \frac{20\, I}{(6{,}25 \cdot 10^4 + 19{,}89\, e \cdot 10^8)} = \frac{20\, I}{(6{,}25 + 19{,}89 \cdot 10^4 e) 10^4}$

ex3 (Suite)

2. On donne $B = 100.10^{-3}$ T.

$$\Phi = B.S = 100.10^{-3} \cdot 4.10^{-4}$$
$$= 400.10^{-7}$$
$$= 4.10^{-5} \text{ Wb.}$$

d'où $$I = \frac{\Phi}{2\mu_0} \cdot (6,25 + 19,89.10^4 \times e)10^4$$

A.mN.

e=0 a) $$I = \frac{4.10^{-5}}{2\mu_0}(6,25 + 0)10^4$$

$$I = 1,25.10^{-1} = 0,125 \text{ A.}$$

e = 0,5 mm

$$I = \frac{4.10^{-5}}{5\mu_0}(6,25 + 19,89.10^4 . 5.10^{-4}).10^4$$

$$= \frac{(6,25 + 19,89)}{5}.10^{-1}$$

$$I = 0,5228 \text{ A.}$$

3. $$W = \frac{1}{2}\Phi_T I$$

a) $$W = \frac{1}{2} N \times \frac{2\mu_0 I}{(6,25 + 19,89.10^4 e).10^4}$$

$$W = \frac{1}{2} \times N\Phi \times \frac{\Phi}{N} . (6,25 + 19,89.10^4 . e).10^4$$
$$(\Phi)$$

$$W = \frac{1}{2}\Phi^2 (6,25 + 19,89.10^4 e)10^4$$

AN: $$W = \frac{1}{2}.(4.10^{-5})^2 (6,25 + 19,89.10^4 . e)10^4$$

$$W = 8.10^{(10+4)}(6,25 + 19,89.10^4 e)$$

$$W = 8.10^{-6} \cdot \left(6,25 + 19,89.10^{4} \cdot e\right)$$

Pour $e = 0$

$$W = 8 \times 6,25.10^{-6} = 50.10^{-6}$$

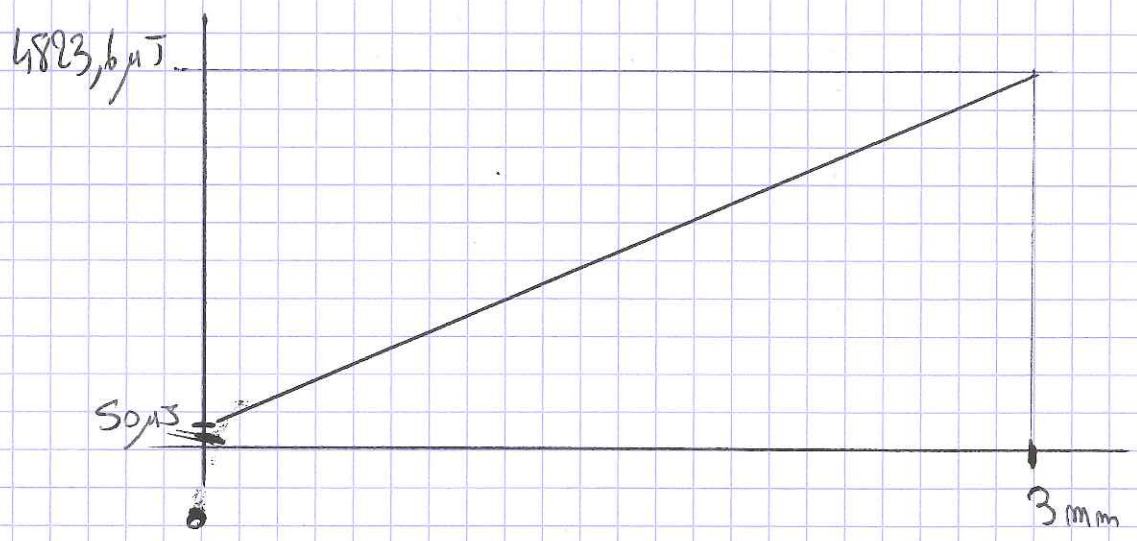
$$W = 50\,\mu J$$

Pour $e = 3$ mm.

$$W = 8.10^{-6}\left(6,25 + 19,89 \times 3.10^{1}\right)$$

$$W = 8.10^{-6}\left(6,25 + 59,67.10^{1}\right)$$

$$W = 4823,6\,\mu J$$



L'énergie est principalement stockée dans l'acier sous forme magnétique.